THE ONAPING INTRUSION, SUDBURY, CANADA – IMPACT MELT AND ROOF ROCKS OF THE SUDBURY IGNEOUS COMPLEX? D. Anders[1], G. R. Osinski[1] and R. A. F. Grieve[1,2], [1]Dept. of Earth Sciences/Centre for Planetary Science and Exploration, University of Western Ontario, Canada (dander53@uwo.ca, gosinski@uwo.ca), [2]Earth Sciences Sector, Natural Resources Canada, (rgrieve@nrcan.gc.ca).

Introduction: The 1.85 Ga [1] Sudbury impact structure is one of the largest impact structures on Earth. The impact basin contains the Sudbury Igneous Complex (SIC); overlain by rocks of the Onaping Formation and post-impact sediments. Igneous bodies – the so called "Onaping Intrusion" (OI) – form sheets and sills at the contact between the SIC and the Sandcherry Member of the overlying Onaping Formation and occupies ~50% of this contact zone [2]. Based on a preliminary recent study, the OI has been interpreted as the roof rocks of the SIC [3]. The present study focuses on two drill cores to further examine the impact melt origin and the relationship to the SIC by a comparison of geochemical data of the OI and the SIC [4].

Core 70011: The 70011 drill core was taken from the North Range of the SIC and is composed of OI from 50' and underlying Granophyre of the SIC starting at 298'. The matrix of the OI is characterized by a skeletal intergrowth of quartz and feldspar indicating a rapid and simultaneous cooling of those minerals within the melt. Microprobe analyses of alkali feldspars and plagioclase revealed only Ca-depleted sanidine and albite compositions which correlates with Pearce Element Ratio plots that show a plagioclase-controlled crystallization of the OI. Secondary minerals, such as chlorite and epidote, distributed within the groundmass, have been formed by alteration of hornblende, pyroxene and biotite due to post-impact hydrothermal activity. Whole rock major element analyses reveal a high amount of SiO_2: 63.63 to 70.44 for the OI and 52.15 to 70.5 for the SIC [4]. Samples of both, the SIC and the OI, plot in the TAS diagram within the subalkalic area. For the SIC the amount of alkalis tends to increase with increasing amount of SIO_2 pointing to a typical differentiation and fractionation trend following Bowen's reaction series. This trend is not as clear for the OI which might be related to rapid cooling of the OI melt. Grain size tends to increase with increasing depth, while the number of target rock clasts encountered within the matrix decrease with increasing depth. This points to the existence of a temperature gradient within the melt assemblage with slower cooling close to the SIC, leading to longer crystallization times and assimilation of more clasts. The clasts are characterized by a rim as a result of interaction processes between liquid melt and clasts. Planar deformation features (PDFs), indicators of shock metamorphsim, occur in clasts and are typically decorated. The contact between Granophyre and OI is abruptly gradational with the first isolated patches of micrographic intergrowth at a depth of 282' within the OI and an increase of graphic intergrowth with increasing depth, becoming the dominant texture at 298'. This implies an interaction between OI and SIC during formation and suggests that they might have originated from the same melt pool.

Core 52847: Core 52847, also drilled from the North Range of the impact structure, consists of the lowest unit of the Onaping Formation, the Sandcherry Member, followed by OI and underlying Granophyre. While the Sandcherry Member occupies ~1000', the OI is only ~50' thick and transition gradational into Granophyre. Investigations show that the contact zone between Sandcherry Member and OI is more or less sharp, no gradational transition has been observed, which implies that Onaping Formation and OI are not genetically related.

Conclusions: The igneous groundmass and shocked clasts clearly demonstrated impact melt origin for the OI. Increasing grain size and decreasing amounts of clasts with increasing depth are general features of roof rocks leading to the hypothesis that the OI is, in fact, the roof rock complex of the SIC. The abruptly transitional contact between Grannophyre and OI suggests a relationship between OI and SIC and a formation from the same melt pool; however, the OI did not undergo a differentiation, as seen in the SIC. A suggested water-rich environment at the time of, and after, the impact might have influenced the formation of both units [2]. In this model, water flowing into the crater interacts with the hot, undifferentiated and highly viscous melt sheet of the SIC, the roof rocks (OI), and the early fallback breccias leading to explosive reactions and the blasting away of the roof rocks in certain regions.

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